

Bill Williams Watershed



BILL WILLIAMS WATERSHED CHARACTERISTICS

SIZE	5,373 square miles (5% of the State's land area).					
POPULATION BASE	Approximately 8,000 people (estimated from the 2000 census). This is less than 0.2% of the state's population.					
LAND OWNERSHIP (Figure 3)	Bureau of Land Management	37%	State Lands	27%	Private land	27%
	Other state and federal		4%	U.S. Forest Service	5%	
LAND USES AND PERMITS (Figure 4)	This watershed is sparsely populated with no significant population centers. Open range grazing is the principal land use, with historic mining scattered across this watershed and with a large mining complex in the Bagdad area.					
	Six wilderness areas are designated in this watershed. These areas are withdrawn from mineral entry and leasing and motorized travel is prohibited; however, grazing still occurs. A National Wildlife Refuge is also established along the Bill Williams near the Colorado River.					
HYDROLOGY AND GEOLOGY	The Santa Maria River and the Big Sandy River drainages merge at Alamo Lake to create the Bill Williams River. Surface water flow is primarily intermittent or ephemeral. Perennial flow is frequently interrupted (short segments). At Planet Ranch, the Bill Williams River flow varies from no flow (many days of the year) to 6,800 cfs (in 1993) (USGS 1996).					
	Elevations in the watershed range from 8,417 feet at Hualapai Peak to 1,000 feet above sea level at Mohave Wash. These elevation differences split the region into two Hydrologic Provinces: Basin and Range Province in the west; Central Highlands Province in the east.					
	Ground water basins include: Bill Williams, Big Sandy, and a portion of Sacramento Valley. Ground water occurs in alluvial deposits, basin-fill, and fractured or porous volcanic rocks. The main water-bearing unit is basin-fill. Alluvial deposits (consisting of gravel, sand, and silt) are found along the Bill Williams River and its tributaries, and have high water-yielding potential. Fractured or decomposed formations of schist, gneiss, and granite also have water-bearing potential. Volcanic rock formations have little water-yielding potential (ADWR 1994).					
UNIQUE WATERS	Burro Creek, Francis Creek, and Peoples Creek are all designated as “Unique Waters”					
ECOREGIONS	Colorado Plateau in the north, Arizona-New Mexico Mountains in the west, and the remaining area is Southern Basin and Range. The biota varies from lowland deserts to upland pine forests.					
OTHER STATES, NATIONS, TRIBES	None.					

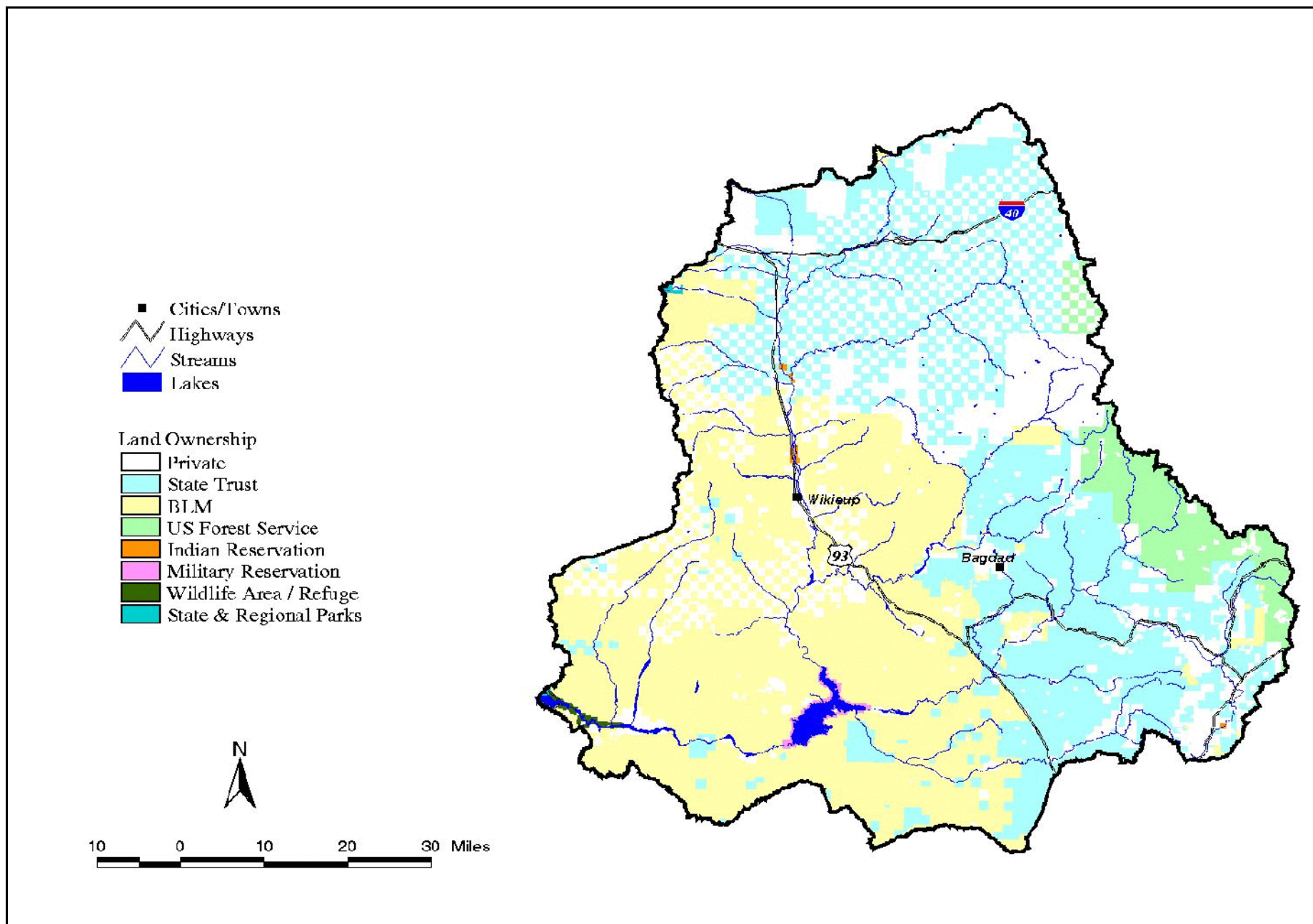


Figure 3. Land Ownership in the Bill Williams Watershed

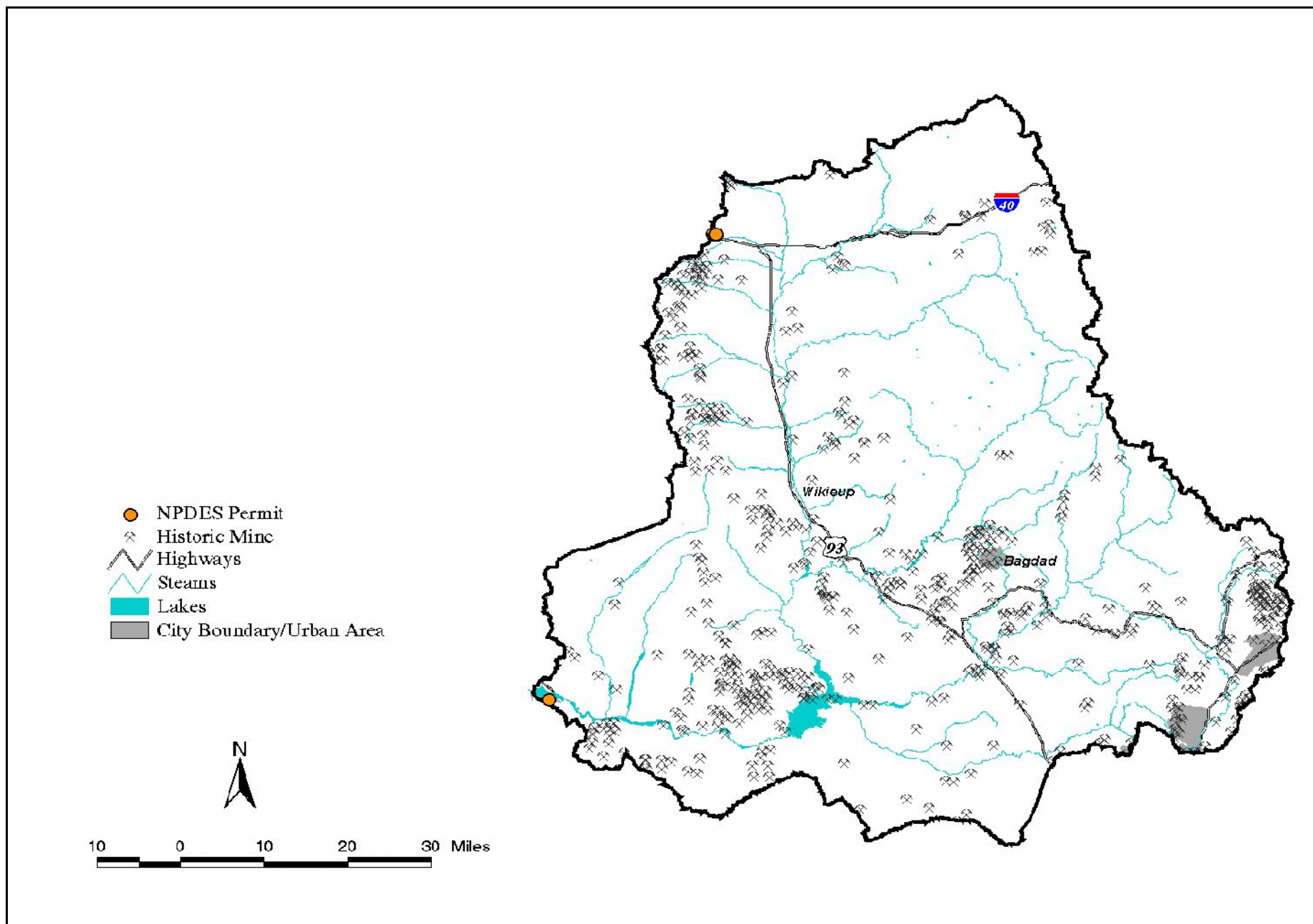


Figure 4. General Land Use and NPDES Permits in the Bill Williams Watershed

Bill Williams Watershed Assessment Discussion

Statistical Summary of Surface Water Assessments

Assessments – For the 2002 assessment, 179 stream miles and 1,414 lake acres were assessed. Fewer assessments were completed than previously because of two factors: 1) changes in assessment criteria requiring more data to base an assessment and 2) a lack of current credible data. This watershed is the focus watershed for monitoring in 2003 and that data will be used in the next assessment.

Water quality assessment information for the Bill Williams Watershed is summarized in the following tables and illustrated on **Figure 5**.

Table 3. Assessments in the Bill Williams Watershed – 2002

	STREAMS		LAKES	
	miles	number of segments	acres	number of lakes
ATTAINING	129	9	0	0
INCONCLUSIVE	18	2	0	0
IMPAIRED	32	2	1,414	1
NOT ATTAINING	0	0	0	0
TOTAL ASSESSED	179	13	1,414	1

PERENNIAL SURFACE WATERS ASSESSED		STREAMS		LAKES	
		miles	number of segments	acres	number of lakes
	Assessed	99	6	1,414	1

* Note that streams with significant perennial stretches within the reach assessed were included in the perennial mileage although part of the reach may have ephemeral or intermittent flow.

Inconclusive assessments – Surface waters with some water quality data but insufficient data to determine if the water is attaining its uses or impaired were

added to ADEQ's new Planning List. Before the end of the watershed monitoring scheduled in 2003, ADEQ expects to have additional water quality data for most of these reaches so that all designated uses can be assessed during the following assessment cycle. Other lakes and streams which lack any water quality data will also be monitored as resources and priorities allow. (See monitoring program discussion in Chapter VII.)

Major stressors—When a surface water is listed as impaired, the pollutants or suspected pollutants causing the impairment are identified. Only two reaches along Boulder Creek and Alamo Lake are to be listed as impaired.

Segments of Boulder Creek are impaired by metals and inorganics. Fluoride impairs Boulder Creek above Wilder Creek. Arsenic, copper and zinc impair the creek between Wilder and Butte Creek, while only arsenic impairs the creek below Butte Creek to Copper Creek. Current TMDL investigations indicate that natural sources and historic mining in the area are the sources of these pollutants. In-stream monitoring indicates that current mining operations in the Boulder Creek drainage are not contributing to the impairment.

Excessive nutrients may be causing the high pH and low dissolved oxygen readings at Alamo Lake, or these water quality problems may be caused by low flows because of an extended drought. In either case, the exceedances of the sulfide standards will be eliminated when EPA approves Arizona's new surface water standards, as exceedances occurred only in the hypolimnion (bottom level of lake water).

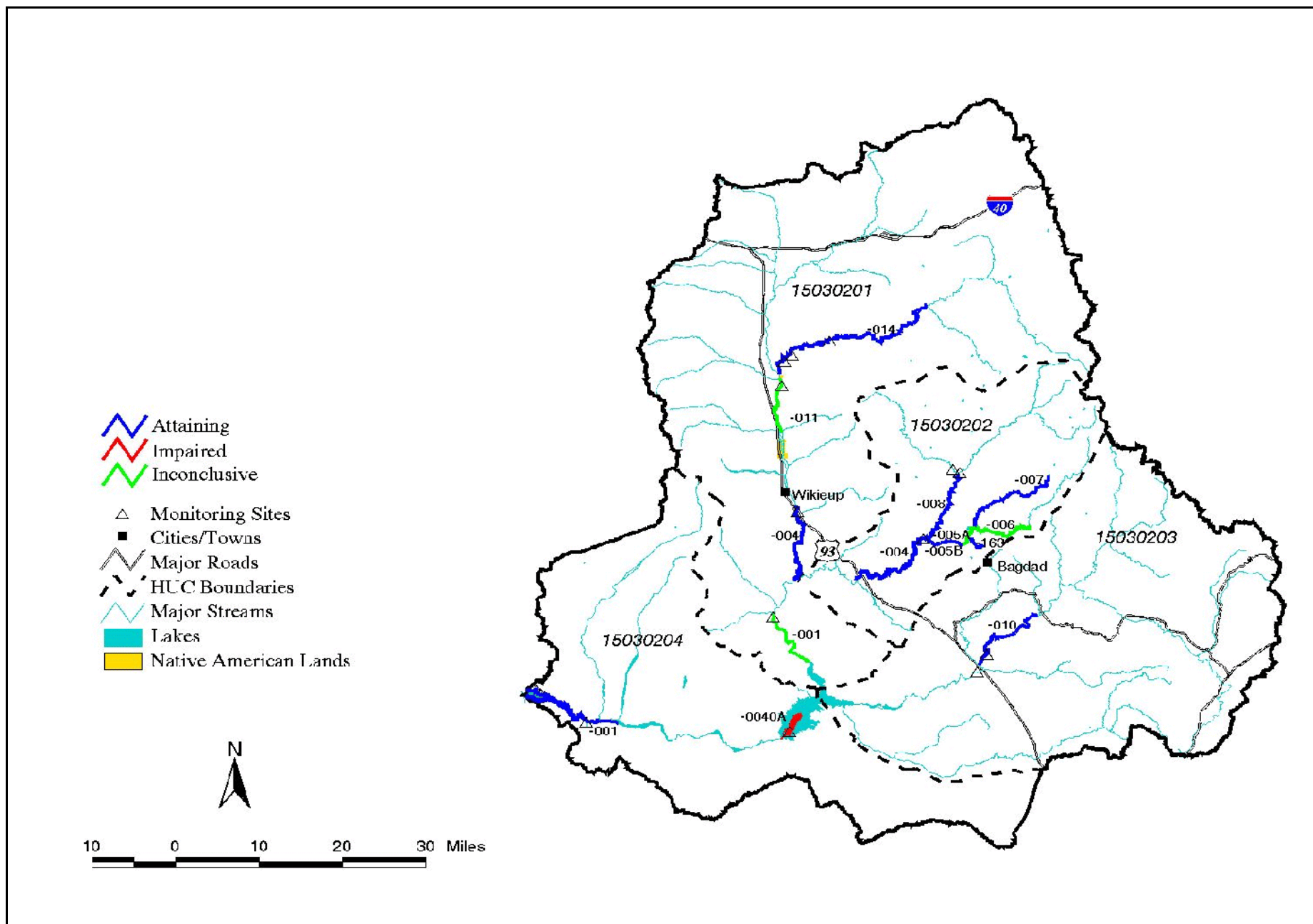


Figure 5. Bill Williams Watershed Surface Water Assessments – 2002

TABLE 4. BILL WILLIAMS WATERSHED -- 2002 ASSESSMENT -- MONITORING DATA TABLE

STREAM NAME SEGMENT WATERBODY ID DESIGNATED USES	AGENCY AND AGENCY PROGRAM SITE DESCRIPTION SITE CODE ADEQ DATABASE ID	YEAR SAMPLED YEARS SAMPLED TYPE OF SAMPLES SAMPLING EVENTS	STANDARDS EXCEEDED AT THIS SITE PER SAMPLING EVENT					
			PARAMETER UNITS	STANDARD (DESIGNATE D USE)	RANGE OF RESULTS (MEAN)	FREQUENCY EXCEEDED STANDARD	DESIGNATED USE SUPPORT	COMMENTS
STREAMS MONITORING DATA								
Big Sandy River Deluge Wash-Tule Wash AZ15030201-011 AW&w, FBC, FC, AgL	ADEQ Fixed Station Below Cane Springs BWBSR041.02 100458	1999 - 4 field	Turbidity NTU	50 (A&Ww)	7 - 66	1 of 4		
	Reach Summary Row	1999	Turbidity NTU	50 (A&Ww)	7 - 66	1 of 4	Inconclusive	ADEQ collected 4 samples in1999. Reach assessed as “inconclusive” due to missing core parameters
	A&Ww Inconclusive FC Inconclusive FBC inconclusive AgL Inconclusive	4 sample events Missing core parameters						
Big Sandy River Sycamore-Burro AZ15030201-004 A&Ww, FC, FBC, AgL	ADEQ Fixed Station Below highway 93, Wickiup BWBSR024.50 100400	1999 - 3 suites, 2 field 2000 - 4 suites	Dissolved oxygen mg/L	6.0 (90% saturation)	4.98-8.2 (69-91% saturation)	2 of 9		Field staff documented that naturally occurring ground water upwelling rather than any anthropogenic activities caused the low dissolved oxygen; therefore, not considered in the final assessment.
	Reach Summary Row	1999-2000	OK				Attaining	ADEQ collected 9 samples in 1999- 2000. Reach assessed as “attaining all uses.”
	A&Ww Attaining FC Attaining FBC Attaining AgL Attaining	9 sampling events						
Big Sandy River Rupley-Alamo Lake North AZ15030201-001 A&Ww, FC, FBC, AgL	ADEQ Fixed Station Near Signal BWBSR011.20 100457	1999 - 5 field, 1 TSS	OK					
	Reach Summary Row	1999	OK				Inconclusive	ADEQ collected a total of 6 field samples in 1999. Reach assessed as “inconclusive” and added to Planning List due to missing core parameters.
	A&Ww Inconclusive FC Inconclusive FBC inconclusive AgL Inconclusive	5 sampling events Missing core parameters						
Bill Williams River point B-Colorado River AZ15030204-001 A&Ww, FC, FBC, AgL	USGS Station #09426600 Near Planet BWBWR005.88 100924	1996 - 2 suites 1997 - 2 suites 1998 - 2 suites 1999 - 2 suites 2000 - 2 suites	Dissolved oxygen mg/L	6.0 (90% saturation) (A&Ww)	4.8-8.4 (55-86%) saturation	1 of 10		Missing core parameters: beryllium and Escherichia coli.
	Reach Summary Row	1997-2000	Dissolved oxygen mg/L	6.0 (90% saturation) (A&Ww)	4.8-8.4 (55-86%) saturation	1 of 10	Attaining	US Geological Survey collected 10 samples in 1997-2000. Reach assessed as “attaining some uses.” Add to Planning List due to missing core parameters.
	A&Ww Attaining FC Attaining FBC Inconclusive AgL Attaining	10 sampling events Missing core parameters.						

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			PARAMETER UNITS	STANDARD (DESIGNATE D USE)	RANGE OF RESULTS (MEAN)	FREQUENCY EXCEEDED STANDARD	DESIGNATED USE SUPPORT	COMMENTS
Boulder Creek headwaters - Wilder Creek AZ15030202-006 A&Ww, FC, FBC, Agl, AgL	Phelps Dodge Bagdad Mine Instream Monitoring Above Hillside Mine Hillside - 2	1997 - 3 suites 1998 - 4 suites 1999 - 1 suite 2000 - 3 suites	OK					Missing core parameters: stream flow, dissolved oxygen, nitrogen, bacteria, beryllium, and boron
	Phelps Dodge Bagdad Mine Instream Monitoring Below Tungstona Mine Tungstona - 1	1997 - 3 suites 1998 - 4 suites 1999 - 1 suite 2000 - 3 suites	Fluoride/Fluorine mg/L	8.4 (FBC)	1.2 - 23.3	8 of 11		
	Phelps Dodge Bagdad Mine Instream Monitoring Above Tungstona Mine Tungstona - 2	1997 - 3 suites 1998 - 4 suites 1999 - 1 suite 2000 - 4 suites	OK					
	ADEQ TMDL Program N Above Wilder Creek	2001 - 7 metals, field 2002 - 1 metal, field	OK					Laboratory Detection Limit for beryllium was not low enough to assess Fish Consumption. Laboratory Detection Limit for dissolved copper was not low enough to assess A&Ww in 5 of 8 samples.
	Reach Summary Row A&Ww Inconclusive FBC Impaired FC Attaining Agl Inconclusive AgL Attaining	1997 - 2000 34 sampling events Missing core parameters	Fluoride/Fluorine mg/L	8.4 (FBC)	1.2 - 23.3	8 of 34	Impaired	Phelps Dodge monitored 3 sites in 1997-2000 with a total of 44 samples. ADEQ monitored 1 site in 2001-2002 (included as part of TMDL investigation of lower reach). Reach assessed as "impaired" due to fluoride. Add to Planning List due to missing core parameters.
Boulder Creek Wilder Creek-Copper Creek AZ15030202-005A A&Ww, FC, FBC, Agl, AgL	Phelps Dodge Bagdad Mine Instream Monitoring Above Copper Creek Boulder - 2	1997 - 2 suites 1998 - 4 suites 1999 - 1 suite 2000 - 3 suites	OK					Missing core parameters: stream flow, dissolved oxygen, nitrogen, bacteria, beryllium, and boron.
	Phelps Dodge Bagdad Mine Instream Monitoring Below Hillside Mine Hillside - 1	1997 - 3 suites 1998 - 4 suites 1999 - 1 suite 2000 - 4 suites	Arsenic µg/L	50 (FBC)	10 - 70	1 of 12		
			pH SU	6.5 - 9.0 (A&Ww, FBC, Agl, AgL)	7.2 - 9.5	1 of 12		
	ADEQ TMDL Program B Below Copper Creek	2001 - 7 metals, field	Arsenic µg/L	50 µg/L FBC	11 - 52	1 of 7		The Laboratory Detection Limit for beryllium samples was not low enough to assess Fish Consumption. Method Detection Limit for dissolved copper was not low enough to assess the Aquatic and Wildlife designated use in 6 of 51 samples.
	ADEQ TMDL Program E Below Butte Creek	2001 - 6 metals, field	Arsenic µg/L	50 µg/L FBC	11 - 76	3 of 6		
	ADEQ TMDL Program G Above Butte Creek and below lower tailings piles	2001 - 7 metals, field	Arsenic µg/L	50 µg/L FBC	<5 - 74	4 of 7		

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			PARAMETER UNITS	STANDARD (DESIGNATE D USE)	RANGE OF RESULTS (MEAN)	FREQUENCY EXCEEDED STANDARD	DESIGNATED USE SUPPORT	COMMENTS
	ADEQ TMDL Program H Below Hillside Mine	2001 - 11 metals, field 2002 - 2 metals, field	Arsenic µg/L	50 µg/L (FBC)	<5 - 287	9 of 13		
	ADEQ TMDL Program J Above Hillside Mine	2001 - 6 metals, field	OK					
	ADEQ TMDL Program JJ At upstream tailings pile	2001 - 3 metals, field 2002 - 1 metals, field	Arsenic µg/L	50 µg/L (FBC)	15-58	1 of 4		
			Copper (total) µg/L	500 µg/L (AgL)	<15 - 15,200	1 of 4		
			Copper (dissolved) µg/L	varies	<15 - 14,400	2 of 4		
			Dissolved oxygen mg/L	6.0 (90% sat.)	5.48 - 8.49	1 of 4		
			Manganese µg/L	10,000 (AgI) 19,600 (FBC)	30 - 23,400	1 of 4		
			Zinc (total) µg/L	10,000 (AgI) 22,000 (FC) 25,000 (AgL) 42,000 (FBC)	100 - 129,000	1 of 4		
			Zinc dissolved µg/L	varies	60-115,000	2 of 4		
	ADEQ TMDL Program L Above Hillside Mine and tailings	2001 - 4 metals, field	OK					

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			PARAMETER UNITS	STANDARD (DESIGNATE D USE)	RANGE OF RESULTS (MEAN)	FREQUENCY EXCEEDED STANDARD	DESIGNATED USE SUPPORT	
	Reach Summary Row A&Ww Impaired FBC Impaired FC Attaining AgI Inconclusive AgL Attaining	1997 - 2000 95 samples 25 sampling events Missing core parameters	Arsenic µg/L	50 µg/L (FBC)	15-58	19 of 69	Impaired	<p>Phelps Dodge monitored 2 sites in 1997-2000 and ADEQ monitored 8 sites with a total of 69 samples. Reach assessed as "impaired" due to arsenic, copper, and zinc. Add to Planning List due to missing core parameters and insufficient method detection limits (beryllium).</p> <p>Data collected by ADEQ after October 2000 was included in this assessment because this newer data showed that the reach should remain on the 303(d) List due to arsenic, copper and zinc impairments. Copper and zinc contamination of Boulder Creek appears primarily at the upper tailing pile and the arsenic contamination extends down to Copper Creek.</p> <p>Old reach was segmented at Copper Creek, as the reach is meeting standards below Copper Creek.</p>
			Copper (total) µg/L	500 µg/L (AgL)	<15 - 15,200	1 of 69	Attaining	
			Copper (dissolved) µg/L	varies (&Ww)	<15 - 14,400	2 of 69 2 within 1 year	Impaired (only below upper tailings)	
			Dissolved oxygen mg/L	6.0 (90% sat.)	5.48 - 8.49	1 of 69	Attaining	
			Manganese µg/L	10,000 (AgI) 19,600 (FBC)	30 - 23,400	1 of 69	Attaining	
			pH SU	6.5 - 9.0 (A&Ww, FBC, AgI, AgL)	7.2 - 9.5	2 of 69	Attaining	
			Zinc (total) µg/L	10,000 (AgI) 22,000 (FC) 25,000 (AgL) 42,000 (FBC)	100 - 129,000	1 of 69	Attaining	
			Zinc dissolved µg/L	varies (A&Ww)	60-115,000	2 of 69 (2 in a 3 years)	Impaired (only below upper tailings)	
Boulder Creek Copper Creek-Burro Creek AZ15030202-005B A&Ww, FC, FBC, AgI, AgL	Phelps Dodge Bagdad Mine Instream Monitoring Below Copper Creek Boulder - 1	1997 - 3 suites 1998 - 4 suites 1999 - 1 suite 2000 - 4 suites	pH SU	6.5 - 9.0 (A&Ww, FBC, AgI, AgL)	7.7 - 9.4	1 of 12		Missing core parameters: stream flow, dissolved oxygen, bacteria, beryllium, and boron.
	Phelps Dodge Bagdad Mine Instream Monitoring Below Copper Creek Boulder - 4	1997 - 2 suites 1998 - 4 suites 2000 - 4 suites	OK					
	ADEQ TMDL Program A Near Burro Creek	2001 - 6 metals, field	Dissolved oxygen mg/L	6.0 (90% saturation)	3.94-11.54	1 of 5		<p>Field staff documented that naturally occurring ground water upwelling rather than any anthropogenic activities caused the low dissolved oxygen; therefore, not considered in the final assessment.</p> <p>Laboratory Detection Limits for all beryllium samples and one dissolved copper sample were not low enough to base an assessment.</p>

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			PARAMETER UNITS	STANDARD (DESIGNATE D USE)	RANGE OF RESULTS (MEAN)	FREQUENCY EXCEEDED STANDARD	DESIGNATED USE SUPPORT	COMMENTS
	Reach Summary Row A&Ww Attaining FC Attaining FBC Inconclusive AgI Inconclusive AgL Attaining	1997 - 2001 28 samples 18 sampling events	OK				Attaining	Phelps Dodge collected 22 samples at 2 sites and ADEQ collected 6 samples at one site. Reach assessed as "attaining some uses." Add to Planning List to pick up missing bacteria, beryllium, and boron samples.
Burro Creek Boulder-Black Canyon AZ15030202-004 A&Ww, FC, FBC, AgL	ADEQ/BLM Unique Waters Monitoring Below Boulder Creek BWBRO011.53 100403	2000 - 3 suites	OK					
	Phelps Dodge Bagdad Mine Instream Monitoring At Suicide Wash Burro 2	1997 - 3 suites 1998 - 4 suites 1999 - 1 suite 2000 - 4 suites	OK					Missing core parameters: stream flow, dissolved oxygen, nitrogen, bacteria, beryllium, and boron
	Phelps Dodge Bagdad Mine Instream Monitoring Below Mammoth Wash Burro - 4	1997 - 2 suites 1998 - 4 suites 1999 - 1 suite 2000 - 3 suites	OK					
	Reach Summary Row A&Ww Attaining FC Attaining FBC Attaining AgL Attaining	1997 - 2000 11 sampling events	OK				Attaining	ADEQ/Beau of Land Mgt. collected 3 samples in 2000. Phelps Dodge collected 23 samples at 2 sites in 1997-2000. This reach is assessed as "attaining all uses."
Burro Creek Francis Creek - Boulder Creek AZ15030202-008 A&Ww, FC, FBC, AgL (Unique Waters)	Phelps Dodge Bagdad Mine Instream Monitoring Above Boulder Creek Burro - 3	1997 - 2 suites 1998 - 4 suites 1999 - 1 suite 2000 - 4 suites	OK					Missing core parameters: stream flow, dissolved oxygen, nitrogen, bacteria, beryllium, and boron
	Reach Summary Row A&Ww Inconclusive FC Attaining FBC Inconclusive AgL Attaining	1997-2000 11 sampling events Missing some core parameters.	OK				Attaining	Phelps Dodge monitoring at 1 site in 1997-2000. Reach assessed as "attaining some uses." Add to Planning List due to missing core parameters.
Burro Creek Pine-Francis Creek AZ15030202-009 A&Ww, FC, FBC, AgL	ADEQ Biocriteria Program Above Francis Creek BWBRO019.21 100426	1997 - 1 suite	OK					
	Reach Summary Row	1997 1 sampling event	OK				Not assessed	Insufficient data to assess.
Butte Creek headwaters - Boulder Creek AZ15030202-163 A&Ww, FBC, FC, AgI, AgL	Phelps Dodge Bagdad Mine Permit Monitoring At Butte Creek Butte - 1	1997 - 2 suites 1998 - 4 suites 2000 - 2 suites	OK					Missing core parameters: stream flow, dissolved oxygen, nitrogen, bacteria, beryllium, and boron

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	Reach Summary Row A&Ww Inconclusive FC Attaining FBC Inconclusive AgI Inconclusive AgL Attaining	1997-2000 8 sampling events	OK				Attaining	Phelps Dodge collected 8 samples between 1997-2000 at this site. Reach assessed as "attaining some uses." Add to Planning List due to missing core parameters.
Conger Creek headwater-Burro Creek AZ15030202-014 A&Ww, FC, FBC, AgL	ADEQ Biocriteria Program Below Conger Springs BWCNG003.82 100432	1997 - 1 suite	OK					
	Reach Summary Row	1997 1 sampling event	OK				Not assessed	Insufficient data to assess.
Francis Creek headwaters-Burro Creek AZ15030202-012 A&Ww, FBC, FC, DWS, AgL	ADEQ Biocriteria Program Above road crossing BWFRA000.79 10555	1997 - 1 dissolved metals and turbidity	OK					
	Reach Summary Row	1997 1 sampling event	OK				Not assessed	Insufficient data to assess.
Santa Maria River South Fork-Bridle AZ15030203-010 A&Ww, FC, FBC, AgI, AgL	ADEQ Biocriteria Program Above Highway 93 BWSMR015.10 100647	1997 - 1 suite	OK					
	ADEQ Ambient monitoring Below Highway 93 bridge BWSMR013.57 100399	2000 - 2 suites	Dissolved oxygen mg/L	6.0 (90% saturation)	4.0 - 9.5 (54 - 103 saturation)	1 of 4		Field staff documented that naturally occurring ground water upwelling rather than any anthropogenic activities caused the low dissolved oxygen; therefore, not considered in the final assessment.
	Reach Summary Row A&Ww Attaining FC Attaining FBC Attaining AgL Attaining	1997 3 sampling events	OK				Attaining	ADEQ monitoring collected 3 samples between 1997-2000. Reach assessed as "attaining all uses."

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Trout Creek Cow Creek-Knight Creek AZ15030201-014 A&Ww, FC, FBC, AgL	ADEQ Fixed Station Network Near Wickiup BWTRT001.79 100397	1999 - 1 suite 2000 - 5 suites	OK					
	ADEQ Biocriteria Program Above Divide Canyon BWTRT006.15 100670	1997 - 1 suite	OK					
	AGFD At canyon wall and pool BWTRT	1997 - 2 Nutrient, NH3, Metals	OK					
	Reach Summary Row A&Ww Attaining FC Attaining FBC Attaining AgL Attaining	1997-2000 9 sampling events	OK				Attaining	ADEQ collected a total of 7 samples at 2 sites and AGFD collected another 2 samples in 1997-2000. Reach assessed as "attaining all uses."
Wilder Creek headwaters-Boulder Creek AZ15030202-007 A&Ww, FC, FBC, Agl, AgL	ADEQ TMDL Project M Near Boulder Creek	2001 - 6 metals, field 2002 - 1 metals, field	OK					Beryllium Laboratory Reporting Limit not low enough to assess Fish Consumption.
	Reach Summary Row A&Ww Inconclusive FC Inconclusive FBC Inconclusive Agl Inconclusive AgL Attaining	2001-2002 7 sampling events Missing core parameters.	OK				Attaining	ADEQ collected 7 samples in 2001-2002 as part of the Boulder Creek TMDL. This reach is assessed as "attaining some uses" and placed on the Planning List due to missing core parameters.
LAKES MONITORING DATA								
Alamo Lake AZL15030204-0040 A&Ww, FC, FBC, AgL	USFWS/COE Routine Monitoring BWALA	1996 - 10 suites 1997 - 11 suites 1998 - 11 suites 1999 - 9 suites 2000 - 10 suites	Sulfide mg/l	0.1 (A&Ww)	0.3-5.0	14 of 34		
			Fecal coliform CFU/100 ml	4000 ((A&Ww, FBC, AgL)	0-14,000	1 of 37		
			Turbidity NTU	25 (A&Ww)	0 - 40.4	2 of 34		
			pH (high) SU	6.5-9.0 (A&Ww, FBC ,AgL)	7.06-10.97	8 of 43		
			Dissolved oxygen mg/L	6.0 90% saturation (A&Ww)	0.02-14.09	8 of 36		Drying conditions

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				PARAMETER UNITS	STANDARD (DESIGNATE D USE)	RANGE OF RESULTS (MEAN)	FREQUENCY EXCEEDED STANDARD	DESIGNATED USE SUPPORT	COMMENTS
	Reach Summary Row		1996-2000	Sulfide mg/l	0.1 (A&Ww)	0.3-5.0	14 of 34	Impaired	US Fish and Wildlife collected samples during 51 sample events in 1996-2000. Lake assessed as “impaired” due to sulfide, high pH, and low dissolved oxygen.
	A&Ww	Impaired	51 samples	Fecal coliform CFU/100 ml	4000 ((A&Ww, FBC, AgL)	0-14,000	1of 37	Attaining	
	FC	Attaining		Turbidity NTU	25 (A&Ww)	0 - 40.4	2 of 34	Attaining	
	FBC	Impaired		pH (high) SU	6.5-9.0 (A&Ww, FBC, AgL)	7.06-10.97	8 of 43	Impaired	
	AgL	Impaired		Dissolved oxygen mg/l	6.0 (90% sat.) (A&Ww)	0.02-14.09	8 of 36	Impaired	

Information for interpreting these Monitoring Tables

- "Segment" designates the beginning and end points of the reach.
- "Waterbody ID" is derived from combining the following: AZ (for streams) or AZL (for lakes) + a US Geological Survey Hydrologic Unit Code + EPA stream reach number or ADEQ lake number.
- "Designated Uses," "Agency," and "Units" (of measurement) abbreviations are defined in Appendix A.
- "Site Code" is an ADEQ derived abbreviation for the surface water basin, stream name or lake name, and the location of the site. For streams, the numbers are the miles upstream from mouth (normally measured as a straight line vector).
- "ADEQ Database ID" -- This is ADEQ's water quality database reference number. If the data is not in this database, no number will be shown.
- "Samples" -- The year and number of water samples is shown. The federal "water year" is used, from October 1st through September 30th, rather than the calendar year. Types of samples:
 - < "Suite" indicates that a broad range of chemical constituents were collected and field measurements were taken (normally inorganics, metals, nutrients, and bacteria.) The chemical constituents monitored are not consistent among the many monitoring entities that provided the data. If the suite did not include the core parameters needed to assess a designated use as "attaining," the missing core parameters are indicated.
 - < "Field" indicates that only field measurements such as dissolved oxygen, pH, turbidity, and water temperature were collected.
 - < If a specific parameter or parametric group (e.g., zinc, metals, bacteria) is named, monitoring was limited to only these parameters
- "Standards Exceeded at this Site per Sampling Event."
 - < Although many parameters may be analyzed, only those exceeding a standard are shown. Other parameters were collected.
 - < "OK" indicates that no standards were exceeded.
 - < The specific standards are shown as a single parameter may have multiple standards depending on the designated uses assigned. (See standards in Appendix C.)
 - < "The Range of Results" indicates the minimum and maximum sample results. If the laboratory reported result is "less than the detection limit" or "not detected," a less than (<) value will be shown along with the detection limit (e.g., <0.5 mg/L).
 - < A mean, geometric mean, or median will be shown along with the range of results if applicable to the standard or assessment criteria.
- < "Comments" include other information used in interpreting the data for assessments, such as evidence that the exceedance is solely due to natural conditions, or that the data does not meet the new "credible" data requirements.
- < In the "Summary Row" parameter exceedances are combined from multiple sites, and the assessment of each designated use is shown. The overall assessment for the surface water is described in the "Comments" field: "Attaining," "Not attaining," "Impaired," or "Inconclusive." See assessment criteria in Chapter III of Volume I.

Ground Water Assessments in the Bill Williams Watershed

Major ground waters stressors – Monitoring data collected from the wells in this watershed between October 1995-October 2000 are summarized in **Table 5** and illustrated in **Figures 6, 7, and 8**. As **Table 5** indicates, wells are sampled for different constituents.

Only 14 wells were monitored in this watershed (**Figure 6**). This is not enough wells to make many statements about water quality. Of the wells monitored, 4 exceeded radiochemical standards and 2 exceeded the fluoride standard. No other standards were exceeded.

Total Dissolved Solids (TDS) concentration – Water quality can be characterized based on concentration of Total Dissolved Solids (**Figure 7**). High levels of salinity limit the practical uses of ground water in this watershed as TDS over 500 mg/L has an off-flavor (8 of 11 wells), and TDS over 1000 mg/L will limit its use for some crops (4 of 11 wells).

No TDS water quality standards apply in this watershed, and the elevated levels of TDS do not present a human-health concern for drinking water. The TDS concentration is only used to generally characterize water quality.

Nitrate concentration – Water quality can also be characterized by looking at the concentration of nitrates in ground water (**Figure 8**). In Arizona, natural occurring nitrate concentrations in ground water are generally below 3 mg/L and concentrations above 5 mg/L may indicate potential anthropogenic sources of nitrate. Nitrates were elevated above 5 in 3 of 11 samples. Elevated nitrates may be due to septic systems or other waste disposal problems.

When nitrate concentrations exceed 10 mg/L, Arizona's Aquifer Water Quality Standard has been exceeded. This standard was set to protect human health, as water with nitrate greater than 10 mg/L may present a health problem for babies and should not be consumed by nursing mothers. No wells exceeded this standard in this watershed; however, efforts need to continue to minimize further contamination of ground water by nitrates.

Table 5. Bill Williams Watershed Ground Water Monitoring 1996 - 2000

MONITORING DATA TYPE	PARAMETER OR PARAMETER GROUP	NUMBER OF WELLS			PERCENT OF WELLS EXCEEDING STANDARDS
		SAMPLED	SYNTHETIC CONSTITUENT DETECTED*	EXCEEDING STANDARDS	
INDEX WELLS	Radiochemicals	7		2	29%
	Fluoride	7		1	14%
	Metals/Metalloids	7		0	0%
	Nitrate	7		0	0%
	VOCs + SVOCs*	7	0	0	0%
	Pesticides	7	0	0	0%
TARGETED MONITORING WELLS	Radiochemicals	3		2	66%
	Fluoride	7		1	14%
	Metals/metalloids	7		0	0%
	Nitrate	7		0	0%
	VOCs + SVOCs*	4	0	0	0%
	Pesticides	4	0	0	0%

WELL CLASSIFICATION BY TOTAL DISSOLVED SOLIDS (TDS) CONCENTRATION				
Total Number of Wells	Wells <500 mg/L Acceptable drinking water flavor	Wells 500-999 mg/L Fresh (not saline) Some crop production problems	Wells 1000-3000 mg/L Slightly saline Increasing crop production problems	Wells >3000 mg/L Moderately saline to briny Severe crop production problems
11	3	4	3	1

WELL CLASSIFICATION BY NITRATE CONCENTRATION (measured as Nitrogen)			
Total Number of Wells	Wells <5 mg/L	Wells 5-10 mg/L May be an anthropogenic source of Nitrates	>10 mg/L Exceeds standards Should not be used for drinking water by babies or nursing mothers
14	11	3	0

*VOCs = volatile organic compounds; SVOCs = semi-volatile organic compounds.

*The detection of a synthetic constituent (pesticides, VOCs, and SVOCs) is noted because some do not have standards and these substances are not naturally occurring in the ground water.

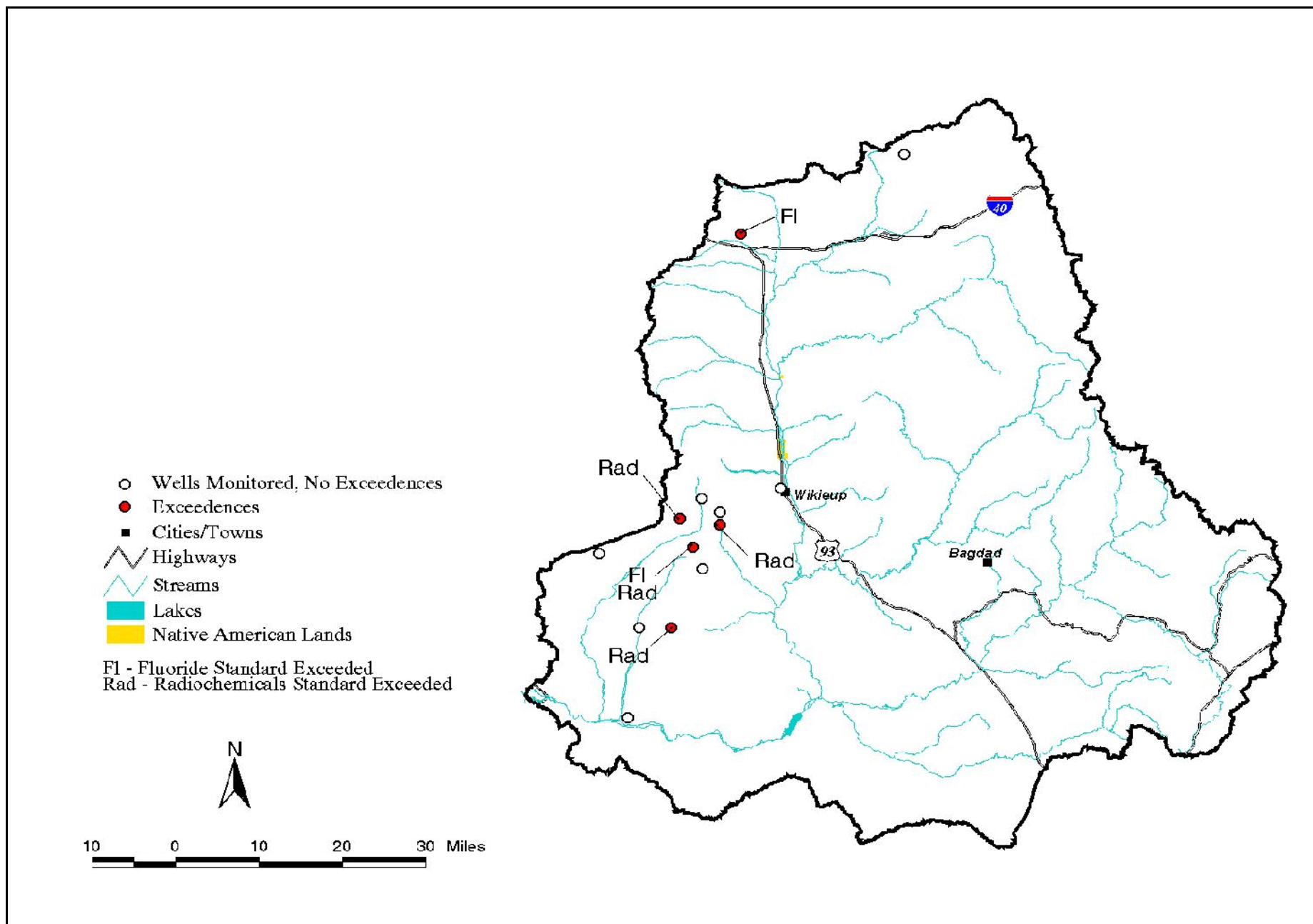


Figure 6. Ground Water Monitoring in the Bill Williams Watershed – 1996-2000

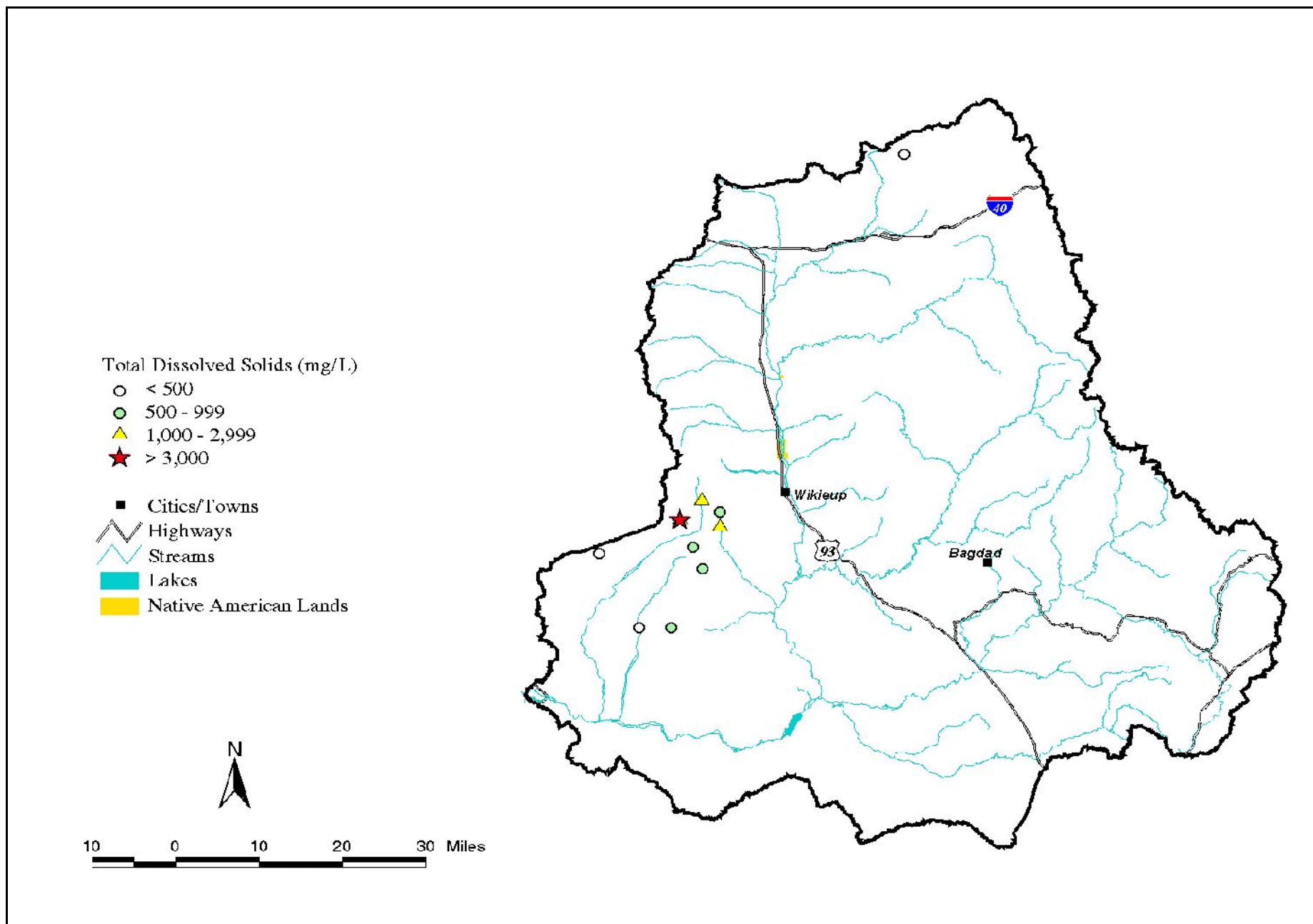


Figure 7. Classification of Ground Water by TDS Concentration – Bill Williams Watershed

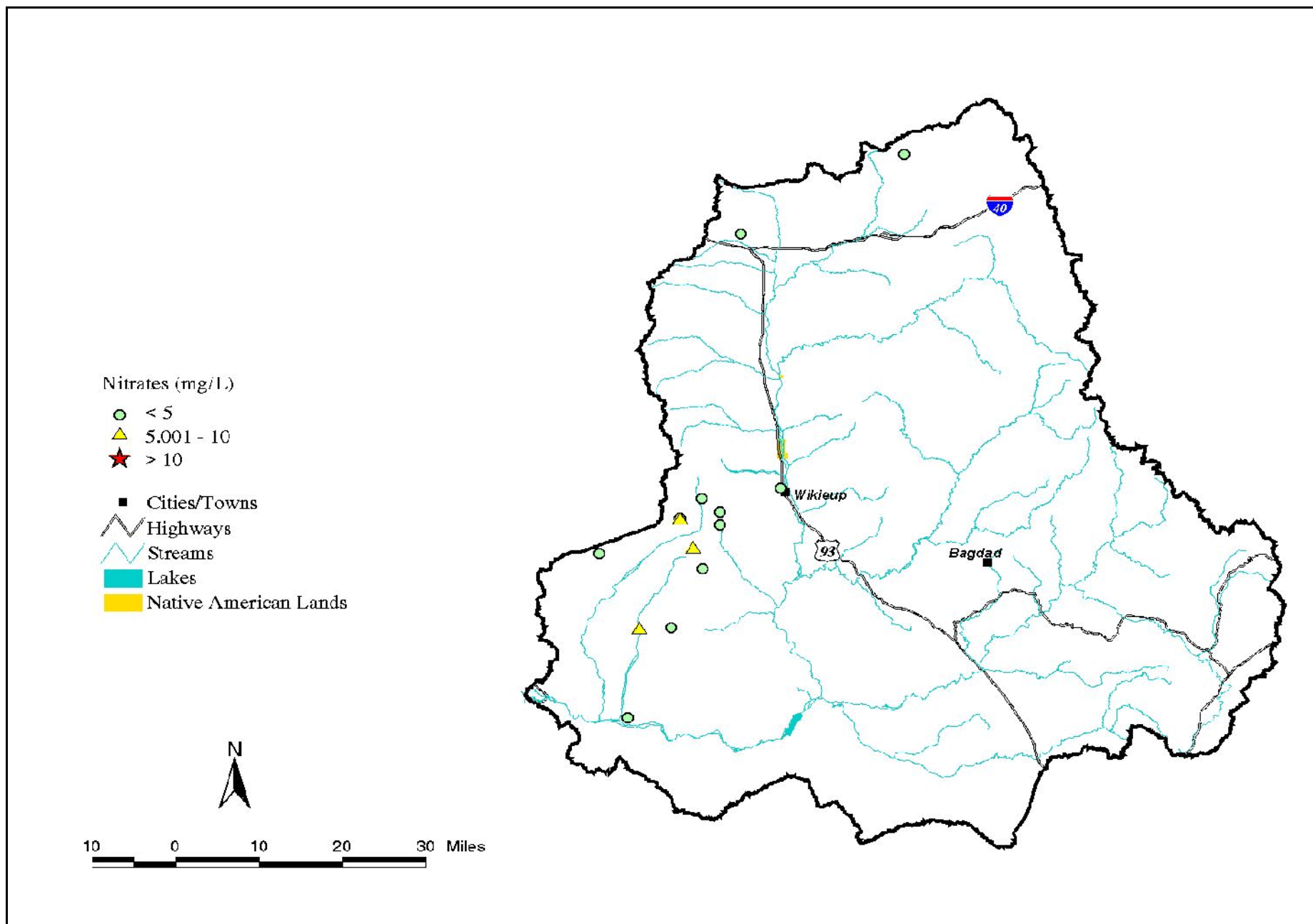


Figure 8. Classification of Ground Water by Nitrate Concentrations – Bill Williams Watershed

Watershed Studies and Alternative Solutions in the Bill Williams Watershed

This section highlights surface and ground water studies, mitigation projects, and remediation activities which have been conducted to improve water quality in the Bill Williams Watershed. Watershed partnerships active in this watershed are also cited.

Surface Water Studies and Mitigation Projects

Alamo Lake Dam Impacts on Down Stream Channels and Riparian Vegetation; Response of Saplings of Three Riparian Species in Bill Williams River, Arizona – This study looked at the impacts of a dam on the indigenous, pioneer vegetation and stream channels along the Bill Williams River, compared to the Santa Maria River (Shafroth, 1999). With the establishment of three woody riparian species along the Bill Williams River this study finds:

- < Stream patterns -- the flood magnitude has been reduced, low flows have increased, the channels have narrowed;
- < Ground water patterns – maximum depth and maximum flow rate of ground water declined;
- < Vegetation patterns – 92-100% of the populus and salix saplings died, while 1-13% of the Tamarisk stems died. 92-100% of the populus and salix saplings died, while 1-13% of the Tamarisk stems died). This resulted in the flood plain contained more patches dominated by salt cedar (*Tamarix ramosissima*), woody vegetation was denser, and mature vegetation declined.

These results show that plant response is dependent on the roots relative to the ground water change, soil texture and stratigraphy, precipitation, adaptations to stress, and tree age.

Total Maximum Daily Load Studies – The following TMDL analysis has been initiated in this watershed. Further information about the status of this or other TMDL investigations can be obtained by contacting the TMDL Program manager Nancy LaMascus at (602) 771-4468 or at ADEQ's web site: <http://www.adeq.state.az.us/envirom/water/assess/tmdl.html>

- **Boulder Creek TMDL Study** – Boulder Creek is a 37 mile long, primarily ephemeral stream that flows into Burro Creek. An 8.5 miles reach (from Wilder Creek to its confluence with Burro Creek) is listed as impaired due to metals. Hillside Mine, an abandoned gold-silver-zinc-lead mine and mill site located alongside Boulder Creek has been the principal source of concern, although other abandoned mines further upstream are also being investigated.

Preliminary findings indicate that material from the tailings pile and a seep at the site are significantly impacting water quality of Boulder Creek. The seep emanates from a collapsed adit, and flows at approximately five gallons per minute. The seep which is high in arsenic, copper, manganese, and zinc is the only contributing source of flow for Boulder Creek during dry periods. Most of the metals dissipate in the reach by Butte Creek, except for arsenic which extends down to Butte Creek.

Water Protection Fund Projects – The following Water Protection Fund projects are in the Bill Williams watershed:

- **Kirkland Creek (Sub-)Watershed Resource Assessment** -- The Triangle Natural Resources Conservation District was funded to conduct a thorough resource assessment of Kirkland Creek. Project personnel will use the information to prepare a long-term action plan, including an implementation schedule for watershed enhancement activities. In addition, project personnel will assist ranches with updating resource management plans. This project has a strong community outreach component, which includes newsletters and public meeting to keep local residents informed and promote community input. To be completed in 2003.
- **Coconino Plateau Regional Water Study** -- The City of Williams is contracting with the U.S. Geological Survey to determine the physical boundaries and flow direction for the systems that supply the major springs of the Coconino Plateau in the Greater Grand Canyon region. The project will examine the geohydrologic controls and provide the

basic data needed to estimate impacts of development on the springs and riparian habitats, through well and spring inventories. The application also proposes to determine additional data needs and analysis required to evaluate the sustainability of natural flows, and will develop a monitoring plan for future collection of baseline data. This project is to be completed in 2002.

- Big Sandy River Riparian Project -- The Bureau of Land Management received funds to restore an 8-mile perennial reach along the Big Sandy River south of the Kingman Resource Area near Alamo Lake. Under this grant, pasture fencing was constructed to help control livestock. Additionally, the development of upland livestock water sources will facilitate the management of livestock. This project was completed in 2000.
- Riparian Vegetation and Stream Channel Changes Associated with Water Management along the Bill Williams River – Arizona State University received funds to produce quantitative data on the relationship between stream flow and historic changes in the riparian community and channel morphology along Bill Williams River below Alamo Dam. This information will be used in an ongoing effort to define reservoir operation regimes that will ensure protection of the riparian habitat downstream of Alamo Dam. The project was completed in 1999.

Improvement Grants or Water Protection Grants.

Ground Water Studies and Mitigation Projects

Ground water Reconnaissance Survey in Mohave County: The watersheds (Sacramento Valley, Big Sandy Valley, Detrital Valley and Hualapai Valley) are all to the south of the Colorado River – (See discussion in the Colorado Grand Canyon Watershed.)

Watershed Partnerships

Upper Bill Williams Watershed Partnership – This partnership's concern has been focused on water quality in Alamo Lake, a recreational magnet for this watershed, and nearby Boulder Creek with its potential for contamination due to historic resource extraction. Recently, the partnership proposed a Phase I Planning Study to develop a water resource plan that would identify key waterbody stressors and potential projects that might qualify for Water Quality